Characterization of Reuse Activities at Contaminated Sites

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Abstract: Given the increased focus on reuse activity within EPA and state site cleanup programs, policy makers would benefit from looking across programs to better understand the extent and nature of reuse; examine site characteristics that influence reuse; leverage lessons learned; and coordinate reuse activities, data collection, and information management. This research paper begins to examine these issues. It reports the results of a preliminary review and analysis of available EPA and state program data on the extent and nature of reuse and factors influencing site reuse. Numerous factors can influence the reuse potential of contaminated sites. Characteristics include on-site factors (e.g., site size and configuration, prior use, type and extent of contamination), as well as off-site factors such as local real estate market conditions. We provide a preliminary analysis of the roles of site contamination type and prior use in influencing reuse potential. To put this analysis in broader context, we also review the literature on the role of off-site factors, and specifically local real estate market conditions, in affecting the reuse potential of contaminated sites. An important finding of this analysis is that EPA and state programs currently do not collect data needed to fully characterize the nature and extent of contaminated site reuse within and across programs, or to determine the relative influence of various factors that influence the potential for reuse after cleanup.

Subject Areas: Hazardous Waste (8), Land Use (26), and Environmental Policy (52)

Keywords: contaminated sites, site reuse, Superfund, brownfields, RCRA, underground storage tanks

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I. Introduction and Overview

The Environmental Protection Agency's primary role in addressing contaminated sites has historically focused on remediation to mitigate human health and environmental risks. The Superfund Program was established to facilitate the assessment and cleanup of the nation's most contaminated sites. EPA oversees cleanups conducted by parties responsible for the contamination, or can cleanup up sites itself using federal dollars in cases where responsible parties cannot be identified. The Resource Conservation and Recovery Act (RCRA) Corrective Action Program was designed to address the cleanup of contaminated areas of facilities that treat, store, and dispose of RCRA-regulated hazardous wastes. The Underground Storage Tank (UST) Program focuses on the assessment and cleanup of releases from underground storage tanks and petroleum-contaminated sites.

In recent years, EPA has focused more attention on returning contaminated sites to productive reuse in addition to remediating them. The Land Revitalization Initiative of 2003 established the goal of integrating land reuse into all EPA cleanup programs. The EPA Brownfields Program, launched in 1996, was specifically designed to promote the integration of cleanup and reuse of contaminated, or potentially contaminated, brownfields. EPA's Office of Solid Waste and Emergency Response (OSWER) programs, including Superfund, RCRA, UST, Brownfields, and the Federal Facilities Restoration and Reuse Program, are now actively engaging in activities to encourage reuse as well as cleanup, and these programs are making significant progress in addressing barriers to reuse and in promoting and tracking reuse activities. State voluntary cleanup and brownfields programs are engaging in similar activities. While all

of these activities and initiatives have the common goal of promoting the reuse of contaminated sites, they are based in programs with very different historical contexts and missions.

Given the increase in reuse activity of EPA and state programs and the likely future focus on reuse, policy makers would benefit from looking across programs to: better understand the extent and nature of reuse; examine site characteristics that influence reuse; leverage lessons learned that help direct limited resources; and coordinate reuse activities, data collection, and information management. This research paper begins to examine these issues. It first reports the results of a preliminary review and analysis of available EPA and state program data on the extent and nature of reuse and factors influencing site reuse. Numerous factors can influence the reuse potential of contaminated sites. Characteristics include on-site factors (e.g., site size and configuration, prior use, type and extent of contamination), as well as off-site factors such as local real estate market conditions. EPA and state programs often collect data on on-site factors, but do not collect data on off-site factors. Therefore, this analysis addresses only on-site factors. To put our analysis of on-site factors in broader context, we also review the literature on the role of off-site factors, and specifically local real estate market conditions, in affecting the reuse potential of contaminated sites. We first present findings of the quantitative analysis of program data, followed by findings of the literature review. We then summarize our findings and conclude by discussing the implications of the results for future efforts to advance the understanding of the reuse potential of contaminated sites.

II. Role of Reuse and Program Data[1]

Over the past decade, the Superfund, RCRA, and UST programs have established initiatives to integrate future land use considerations into the cleanup process. In 1996, the Office of Brownfields Cleanup and Redevelopment (OBCR) was established to incorporate reuse as a central component of cleanup activities, and the office has worked with state and local governments to test strategies for promoting the reuse of brownfields sites. Many states work in cooperation with EPA to cleanup Superfund sites and manage delegated RCRA and UST programs, and have developed and implemented brownfields programs; states are also increasingly focused on promoting reuse within these cleanup programs. Thus, many different programs managed by public agencies at all levels share the common goal of promoting reuse of contaminated lands and are conducting similar activities—financial assistance, technical assistance, liability assurance—to promote reuse. Until now, however, there has been no comprehensive effort look across available program data to understand the extent and nature of reuse or the factors that influence reuse. EPA led a recent effort to collect cross-program information on reuse and local impacts of reuse at 25 sites which included Superfund, brownfields, RCRA, UST sites across the country. Results of the research were presented in a series of site fact sheets. A summary of the site characterization information extracted from these fact sheets is presented in Appendix A. The sample consists of 25 sites and the sites were selected to cover a diverse range of reuse types. The case studies provide some insights regarding reuse but it is difficult to draw program-wide conclusions from them because the sample of 25 sites is relatively small and not random.[2]

While most EPA cleanup programs have not formally implemented the collection and management of reuse data in program procedures, the Superfund and Brownfields programs have made significant progress in developing a framework for tracking environmental indicators related to cleanup and reuse. Once implemented, resulting indicator data will provide a starting point for characterizing the extent and nature of reuse. In this section, we provide an overview of the role of reuse in EPA and state cleanup programs, and review and analyze available data pertaining to characterizing reuse within each program. Available data related to the beneficial effects of reuse are not addressed.[3]

Superfund

The Superfund Program was established by statute in 1980 to facilitate cleanup of the nation's most contaminated sites. Superfund Program activities include removal of hazardous materials, assessments of potentially contaminated sites, oversight of site cleanups, and research on remediation technologies. Sites covered by Superfund include abandoned or uncontrolled industrial sites, federal facilities, landfills, and hazardous waste disposal areas. Superfund sites that pose especially high risks to human health or the environment are placed on the National Prioritites List (NPL) and given access to federal cleanup funds; cleanup of NPL sites is typically overseen by EPA as opposed to state agencies.

In 1999, EPA created the Superfund Redevelopment Program to help put Superfund sites back in productive reuse. The program provides funding to local governments to participate in the cleanup of Superfund sites and plan for future reuse.

Since 1999, EPA has provided funding to nearly 70 pilot cities to assist with activities such as remedy selection, and reuse planning, and community outreach.[4] The goal of the program is to establish an effective process and provide the tools and information needed to fully explore future uses, before the cleanup remedy is implemented. This should result in remedies that are consistent with the likely future site uses, and improves opportunities for communities to benefit from productive use of sites following cleanup.

Extent and Nature of Reuse at NPL Sites

We examined the extent and nature of reuse at NPL sites using two main data sources — the Superfund Redevelopment (SURE) database and the Superfund CERCLIS database. SURE was recently developed by the Superfund Redevelopment Program to track the reuse of Superfund sites that have been reused or are planned for reuse. Currently, the database contains information on 375 sites, 355 of which are NPL sites and all are reused sites. The database includes data on site characteristics, reuse, and economic impacts.[5] The SURE database is still under development and therefore documentation on its contents and methods of data collection are not currently available. While the database is purported to include all reused Superfund sites, there may be Superfund sites with reuse activities underway or completed that are not included in the SURE database, and there may be sites included that are not truly reused sites. The lack of documentation available on the database makes it difficult to assess its quality. While the SURE database only includes information on reused sites, the Superfund CERCLIS database tracks information on location, status, contaminants, and cleanup activities for *all* Superfund sites being assessed as potential or current NPL sites.

Exhibit 1 presents the reuse status of NPL sites with known reuses or reuse plans.[6] Of the 355 NPL sites tracked in SURE, 335 sites have information on reuse activities. Of these sites, 138 sites have a new use in operation that differs from the previous use, and 94 sites are planned for new uses, totaling 69 percent of the sites with site use information. Eight sites are described as being restored to their prior use, and 95 sites are described as having "actual continued use," the definition being that the site has been used productively during and after cleanup. These sites total 31 percent of sites with usage information in SURE. It is not clear if these sites are continuing with a prior use, or if the use underwent a change sometime during the remediation and redevelopment process. It should be noted that these data are preliminary. Categories of use information contained in SURE are somewhat nebulous, and reuse plans may change for sites that are in earlier stages of reuse planning.

Exhibit 1

REUSE STATUS OF NPL SITES IN THE SURE DATABASE

Reuse Status Description	Number of Sites
New Use in Operation	138
Productive Use During and After Cleanup	95
New Reuse Planned	94
Restored to Prior Use	8
Total NPL Sites with Reuse Status Data	**335**
Total Number of NPL Sites "Reused"	**355**
Total Number of NPL Sites	**1948**

Sources: SRA International, Superfund Redevelopment Initiative, SURE Database, January 5, 2004; CERCLIS Database January 2004 (see Appendix B for additional detail on total number of NPL sites).

We also analyzed remedial actions at NPL sites with known reuses or reuse plans using the SURE database. Not surprisingly, we found that reused sites employ multiple types of remedial actions at each site. As shown in Exhibit 2, institutional controls are used at 72 percent of the sites (246 sites). Institutional controls are non-engineered instruments, such as administrative and/or legal controls, that help minimize the potential

for human exposure to contamination and/or protect the integrity of a remedy by limiting land or resource use.[7] It should be noted, however, that SURE has broadly categorized institutional controls, and that fencing is counted as an institutional control and is used at 54 percent of the sites that use institutional controls. Deed and access restrictions are also common institutional controls, found at 36 percent and 33 percent of sites with institutional controls, respectively. In addition, 65 percent of reuse sites utilized containment remedies which prevent release of contaminants using barriers such as caps and slurry walls. More than 65 percent of reuse sites utilized ex-situ physical/chemical treatment (i.e., removal and treatment of contaminated media); and 20 percent used in-situ physical/chemical treatment (i.e., treatments that clean contaminated media without removing it).

Exhibit 2

REMEDIAL ACTIONS AT NPL REUSE SITES

Number of Sites	Percent of Sites	Remedial Action
328	96	Other
246	72	Institutional Controls
223	65	Containment
222	65	Physical/Chemical Treatment (Ex-Situ - Assuming Excavation)
192	56	Physical/Chemical Treatment (Ex- Situ - Assuming Pumping)
102	30	Physical/Chemical Treatment (Ex-Situ)
79	23	Air Emissions/Off-Gas Treatment
76	22	Residuals (Secondary) Treatment
69	20	Physical/Chemical Treatment (In-Situ)
37	11	Biological Treatment (In-Situ)
26	8	Thermal Treatment (Ex-Situ - Assuming Excavation)
23	7	Biological Treatment (Ex-Situ - Assuming Excavation)
18	5	Thermal Treatment (Ex-Situ)
15	4	Biological Treatment (Ex- Situ - Assuming Pumping)
6	2	Thermal Treatment (In-Situ)
1,662	**Total Entries for Remedial Action**	
341	**Total Sites with Remedial Action Data**	

Source: SRA International, Superfund Redevelopment Initiative, SURE Database, January 5, 2004.

Finally, we found that commercial reuses dominate other types of reuses; 44 percent of all reuse sites involve commercial development. Interestingly, recreational reuse is the second most common land use at these sites (20 percent), and 17 percent of sites have industrial reuses. Only 10 percent of the sites have residential reuses. Some sites are redeveloped with a mix of uses. These results are presented in Exhibit 3.

Exhibit 3

REUSE TYPES AT NPL REUSE SITES

Number of Sites	Percent of Sites	Reuse Type
146	43.6%	Commercial
66	19.7%	Recreational
58	17.3%	Industrial
42	12.5%	Ecological
35	10.4%	Public
32	9.6%	Residential
29	8.7%	TBD
11	3.3%	Agricultural
2	0.6%	Military
0	0.0%	Commercial/Recreational
418		**Total Entries for Reuse Type**
335		**Total Sites with Data on Reuse Type**

Source: SRA International, Superfund Redevelopment Initiative, SURE Database, January 5, 2004.

Characteristics of Reused and Non-Reused Sites

The data available to compare the characteristics of reused and non-reused Superfund sites are limited to SURE and CERCLIS data. While EPA intends to link these data sets, that feature is not available in current version of SURE. Therefore our comparative analysis is limited to a comparison of reused NPL sites (in SURE) to the general universe of NPL sites (in CERCLIS). Because most site characteristics are not coded and tracked in both databases, this analysis is limited to examination of contaminants and prior uses at NPL sites.

Analysis of Contaminants

We analyzed contaminants at the 355 NPL "reuse" sites (in SURE) in comparison to all NPL sites (in CERCLIS) to identify possible relationships between specific contaminants and reuse potential. Contaminant data were not available for all sites in CERCLIS or SURE, and comparison of contaminants across the databases is hampered by apparent differences in extent of contaminant data.[8] As shown in Exhibit 4 a comparison of the top ten most common contaminants represented in CERCLIS and SURE reveals similarities in the proportional representation of contaminant categories across reused NPL sites and the general population of NPL sites.[9] The most common contaminant categories for both reused and non-reused sites are metals, volatile organic compounds (VOCs), and polyaromatic hyrdrocarbons (PAHs). For each chemical, we tested the significance of the differences in the proportion of each contaminant for reuse sites and non-reuse sites using the "z" test for comparing two population proportions. None of the differences were found to be significant. This is not a surprising finding because the extent of contamination (e.g., areal extent, concentration and toxicity) is likely a more important factor in reuse potential than the type of contamination. The areal extent and concentration of contamination influences the cost of cleanup and therefore the feasibility of reuse. The data currently available in SURE and CERCLIS do not allow for analysis of these factors.

Exhibit 4

COMPARISON OF TOP TEN CONTAMINANTS AT ALL NPL SITES AND REUSED NPL SITES

	ALL SITES (CERCLIS)		REUSE SITES (SURE)	
Contaminant	**% Contaminant Occurrences**	**% Sites with Contaminant**	**% Contaminant Occurrences**	**% Sites with Contaminant**
VOC	18.8%	51.8%	18.7%	84.6%
Metals	18.2%	50.2%	18.8%	84.9%
PAH	13.3%	36.8%	12.6%	57.0%
Base Neutral Acids	11.7%	32.2%	11.4%	51.5%
Inorganics	10.3%	28.3%	9.7%	43.8%
Pesticides	8.0%	22.1%	7.3%	33.1%
PCBs	7.8%	21.5%	7.5%	33.8%
Dioxins/Dibenzofurans	3.9%	10.8%	4.8%	21.7%
Organics	2.6%	7.1%	2.8%	12.5%
Nitroaromatics	1.3%	3.5%	1.7%	7.7%
Other	4.1%	11.2%	4.6%	20.6%
% Total	**100%**		**100%**	

Analysis of Prior Uses

We also compared prior uses at the 355 "reuse" sites to prior uses for all NPL sites to identify possible relationships between prior uses and reuse potential. This analysis comparing the prior uses of reused NPL sites and all NPL sites was also conducted using the SURE and CERCLIS databases. As with the analysis of contaminants, only a portion of the sites in both databases had prior use information.[10] In comparing the proportions of prior uses for reused NPL sites versus all NPL sites, some of the differences are significant as shown in Exhibit 5. We found a significant difference between reused sites and all sites for the following prior uses: federal facility, industrial waste treatment, landfill, manufacturing plant, military-related, and other uses. Sites that were federal facilities and manufacturing plants prior to cleanup were more proportionately represented among reused sites than all sites. Thirty-six percent of reused sites were previously manufacturing plants, but only 20 percent of all sites were manufacturing plants. Similarly, federal facilities represent 12 percent of reused sites but

only six percent of all sites. This positive correlation between reuse and prior use as manufacturing sites and federal facilities may be attributable to a large portion of manufacturing and federal facilities among the 95 sites characterized in the SURE database as "actual continuing use." If the reuse definition did not include "actual continuing use," manufacturing and federal facilities might not be more frequent among reused sites than all sites. On the other hand, sites that were previously landfills, industrial waste treatment facilities, and military-related sites had significantly lower representation among reused sites. The reasons that sites with these prior uses are less likely to be reused are not readily apparent. None of the other prior uses analyzed showed statistically significant differences between reuse sites and all sites, therefore there is no relationship between these prior uses and the potential for reuse or continuation of use post-cleanup.

Exhibit 5

COMPARISON OF PRIOR USES AT ALL NPL SITES AND REUSED NPL SITES

Prior Use	All Sites (CERCLIS)		Reuse Sites (SURE)	
	# Sites	% Sites	# Sites	% Sites
Chemical Plant	122	8.83%	38	11.52%
Federal Facility (non-military)	**82**	**5.94%**	**40**	**12.12%**
Housing Area/Farm	20	1.45%	8	2.42%
Industrial Waste Treatment	**153**	**11.08%**	**16**	**4.85%**
Landfill	**270**	**19.55%**	**42**	**12.73%**
Manufacturing Plant	**265**	**19.19%**	**118**	**35.76%**
Military Related	**61**	**4.42%**	**2**	**0.61%**
Mines/Trailings	86	6.23%	15	4.55%
Other	**274**	**19.84%**	**38**	**11.52%**
Pure Lagoons	31	2.24%	11	3.33%
Radioactive Site	17	1.23%	2	0.61%
Total Sites with Prior Use Information	**1,381**	**100%**	**330**	**100%**

Note: Prior uses highlighted in bold font indicate there is a statistically significant difference, at the 95% confidence level, between the proportions for reused and all sites, based on the "z" test for comparing two population proportions.

Brownfields

Unlike other EPA programs that currently address reuse of contaminated properties, the EPA Brownfields Program was specifically designed to promote the reuse of brownfield sites, "properties, the expansion, redevelopment, or reuse of which may be complicated by the presence of a hazardous substance, pollutant or contaminant."[11] As such, an important focus since its inception in 1995, has been on the integration of cleanup and reuse. The stated mission of the program is "to empower states, communities, and other stakeholders in economic development to work together in a timely manner to prevent, assess, safely clean up, and sustainably reuse brownfields."[12] To fulfill this mission, the Office of Brownfields Cleanup and Redevelopment (OBCR) provides financial and technical assistance for brownfields revitalization, including grants for environmental assessment and cleanup awarded to local governments and non-profit organizations, and grants to assist states and tribes in the development of state brownfields programs. Through these collaborations, EPA's assistance leverages state, local, and private investments in brownfields redevelopment.

Given its focus on reuse, the Brownfields Program is intent on collecting reuse information, including data on site characteristics and community impacts of reuse, but data collection is complicated by the program's implementation at the local level. As part of the Brownfields Economic Redevelopment Initiative, the Brownfields Management System (BMS) database was developed to track performance measure information reported by EPA Brownfields Program grantees. To date, however, the data available from BMS are of limited use in characterizing the nature of reuse because of incomplete reporting. Of the 437 pilot communities that have received EPA Brownfields

Program pilot funding, 40 percent report that they have reuse activities underway. Within these communities, EPA knows of 732 properties with reuse activities reported.[13] However, pilot community reporting is variable and the proportion of pilot communities reporting reuse activities is not known, so the above reuse statistics likely underestimate the extent of reuse at sites in communities receiving EPA Brownfields Program funding. Information on the types of reuse activities at brownfields sites is in text form and is not consistently reported. Property- and parcel-level data fields in the BMS include acreage, media affected, contaminants, former uses, and cleanup activities; however, data collection and population of these fields is limited.[14]

The recent development of a new protocol developed by OBCR for collecting data on specific environmental indicators will likely enable more comprehensive analyses of site characteristics and the extent and nature of reuse on brownfields properties receiving EPA Brownfields Program funding. The new Property Profile Form, which grantees will be required to complete and maintain, contains data fields for the type of contamination, current use, prior use, media affected, institutional controls, response actions, acres cleaned up, redevelopment activities, and acres of green space created.

RCRA

The Resource Conservation and Recovery Act (RCRA) was enacted in 1976 with the primary goals to protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound

manner. Activities at facilities that treat, store or dispose of hazardous wastes sometimes release hazardous waste or hazardous constituents into the environment. Owners or operators of these facilities are responsible for investigating and cleaning up releases from their facilities. EPA's RCRA Corrective Action Program oversees these cleanups, although some cleanups are overseen by states. There are approximately 3,800 sites in the Corrective Action program nationally.

Some RCRA Corrective Action facilities are potential RCRA Brownfields, defined by EPA as "a RCRA facility or portion of a RCRA facility that is not in full use, where there is redevelopment potential, and where reuse or redevelopment of that site is slowed due to real or perceived concerns about actual or potential contamination, liability, and RCRA requirements."[15] The RCRA Brownfields Prevention Initiative was launched in 1998 to encouraged the reuse of potential RCRA Brownfields. The goal of the initiative is to capitalize on the redevelopment potential of RCRA Brownfields to achieve successful cleanup and long-term sustainable reuse that benefits communities. EPA has undertaken several efforts that enhance its RCRA Brownfields Prevention Initiative goals, including a RCRA Brownfields Pilot Program to encourage and showcase innovative approaches to RCRA cleanups at potential RCRA Brownfields, and the Targeted Site Effort Program to spur cleanup at RCRA sites with significant reuse potential.

While the Superfund and Brownfield Programs are making significant strides towards tracking reuse information, there is no parallel effort within the RCRA Program to collect reuse data. Information on the extent of reuse in the RCRA Program is limited

to general reporting in program reports; pilot project descriptions; and success stories on RCRA Cleanup Reforms, the RCRA Brownfields Prevention Initiative, and the Targeted Site Effort Initiative. RCRA success stories and pilot project descriptions related to these initiatives include anecdotal reuse information, such as reuse type, prior use, surrounding use, acreage, contaminant, and response actions. Because project descriptions are available for only a select few RCRA sites, a characterization of the extent of reuse across all RCRA sites is not currently possible. Also, it is likely that continued use or restored use would be more prevalent than a new reuse at RCRA Corrective Action sites, given that a large proportion of Corrective Action sites continue to operate during cleanup.

The RCRA Program does maintain databases with site information related to contamination and cleanup: Resource Conservation and Recovery Act Information (RCRAInfo) and RCRA Corrective Action Implementation Database (RCAID). RCRAInfo provides general information, site location, and cleanup activities for hazardous waste handlers. RCAID includes the type, extent, and impact of contamination, remedial actions selected, and current land use for a random sample of RCRA Corrective Action facilities. Neither database includes reuse information that would enable an analysis of the extent of reuse across all RCRA facilities.

UST

The UST Program focuses on the assessment and cleanup of releases from underground storage tanks and petroleum-contaminated sites. The Office of Underground Storage Tanks (OUST) was created in 1985 to carry out a Congressional mandate, under

RCRA Subtitle I, to develop and implement a regulatory program to address the threat that leaking underground storage tanks (USTs) pose to groundwater. Because of the large universe of regulated USTs, OUST designed a program that is implemented by the states. In addition to regulations requiring preventative measures, UST regulations require corrective action at sites where leaks have occurred. OUST manages the Leaking Underground Storage Tank Trust Fund which is used to oversee and enforce cleanups, and pay for cleanups at sites where the owner/operator is unknown or unable to pay.

The Office of Underground Storage Tanks is responsible for promoting the cleanup of UST sites. Of the 440,000 UST sites nationwide, 300,000 have completed cleanups (68 percent), and many more are underway. One key element of this program is to work together with federal, state, and local organizations and private partners to foster the reuse and subsequent economic recovery of petroleum-contaminated sites. An important tool for supporting this activity is federal brownfields assessment and cleanup grant funding. Recognizing that many of the nation's brownfields are impacted by underground storage tanks or some type of petroleum contamination, Congress expanded the original EPA Brownfields Program to make petroleum sites eligible for brownfields assessment and cleanup grant funding, in the January 2002 Small Business Liability Relief and Brownfields Revitalization Act. Prior to the enactment of this law, petroleum-contaminated sites were eligible for funding through the USTfields Initiative. A total of 50 high-priority petroleum-impacted sites were each awarded up to $100,000 for assessment, clean up, and preparation for reuse.

There is no current effort within the UST Program to collect comprehensive data on site reuse. Summaries of pilot projects provide brief backgrounds and information on objectives, local partners, and contacts for each pilot project. The intended future use of sites is reported consistently across all pilot summaries, whereas information on site characteristics varies significantly. Site characteristics mentioned in the pilot summaries include prior use, surrounding land use, general economic status of the community, extent of contamination, type of contamination, site acreage, and response actions.

The UST Program reports semi-annually on its activities. These reports provide aggregated information on the number of releases, cleanups initiated, cleanups completed, and emergency responses for underground storage tank sites across regions and states.[16] Information on site reuse has not been tracked and included in these reports.

State Programs

States have their own hazardous waste site cleanup programs to address properties that are not addressed under federal programs. EPA works closely with states and tribes to develop partnerships that encourage cleanup of non-NPL hazardous waste sites. Accordingly, EPA provides funding to assist states in building the capacity of their voluntary cleanup programs. This funding supports effective state and tribal programs and promotes cooperation between states, tribes, and regions in the cleanup of contaminated properties.

While most states collect data and report on many factors related to site cleanup, the availability of reuse information is less comprehensive and varies across states. Some

states provide aggregated reuse information in program reports, while others provide more site-specific data through case study descriptions.

We identified 12 states with well-established reuse initiatives and searched for data on reuse frequency and characteristics for each of those states. Appendix C summarizes our research on the availability of state program information on such reuse indicators as the number of contaminated sites, number of reused sites, contaminants, reuse type, prior use, and response action. For most of the 12 states, reuse information is collected through the states' brownfields and/or voluntary cleanup programs. Six of the 12 states — California, Illinois, Massachusetts, Michigan, New Jersey, and Texas — have developed databases to track site-specific information related to cleanup, as part of their efforts to evaluate progress in cleanup programs. Although indicators vary across states, most of these state databases provide information on site location, type of contamination, cleanup status, and response action. Of the six databases reviewed, California is the only state that has compiled reuse information in a publicly-available database.[17]

Given the availability of reuse information in California's CalSites database, we analyzed the types of reuse and prior use of high priority, contaminated sites in California (i.e., state Superfund sites). Of the 706 sites included in CalSites, 135 (19 percent) are reported to have been reused. The remaining 571 sites do not report type of reuse, and are therefore assumed not to have been reused.[18] As shown in Exhibit 6, reuse types are split very evenly among commercial, industrial, and residential development in California, each occurring at between 36 and 39 percent of reused sites. Some sites had

multiple reuses; therefore, the total number of reuses is greater than the number of reused sites.

Exhibit 6

TYPE OF REUSE FOR CALIFORNIA STATE SUPERFUND SITES

Types of Reuse	Number of Sites	% Reused of Sites
Commercial	53	39%
Industrial	49	36%
Residential	50	37%
Unknown	17	13%
Total *	**169**	
Total # Reused Sites	**135**	
Total # Sites in CalSites	**706**	

* Total exceeds total number of reused sites because some sites have multiple reuses.
Source: State of California CalSites Database, January 2004.

CalSites also contains data on the prior uses of California Superfund sites in the form of SIC codes for the type of industry primarily responsible for the hazardous substances at each property.[19] Fifty-five SIC codes are represented. Using this information, we compared prior uses of reused and non-reused sites. The results of this analysis are presented in Exhibit 7. For both groups, prior use as national security/international affairs was the most predominant, approximately 24 percent for reused sites and 14 percent for non-reused sites. The larger percentage for reused sites represents a statistically-significant difference. Chemicals and allied products manufacturing is also a common prior use in both groups, approximately 11 percent for reused sites and 8 percent for non-reused sites. This difference is not statistically-significant. There are also small but statistically-significant differences between the proportions of reused sites and proportions of non-reused sites for the following prior uses: business services, electronic manufacturing, instrument manufacturing, rubber and plastics manufacturing, non-classifiable establishments, personal services, and

transportation by air. For all of these prior uses, the proportion of reused sites with the given prior use is less than the proportion of non-reused sites with that prior use. They are all prior uses at less than nine percent of reuse and non-reuse sites. Combining all manufacturing-related SIC codes indicates that 43.7 percent of non-reused sites and 44.4 percent of reused sites had prior manufacturing uses. The small difference between reused and non-reused sites is not statistically significant.

Exhibit 7

PRIOR USES OF CALIFORNIA STATE SUPERFUND SITES

	Non-Reuse Sites		Reuse Sites	
Prior Use	**# Sites**	**% Sites**	**# Sites**	**% Sites**
Administration of Human Resources	4	0.71%	1	0.74%
Agricultural Production - Crops	3	0.53%	1	0.74%
Agricultural Production - Livestock	1	0.18%	0	0.00%
Agricultural Services	11	1.94%	3	2.22%
Auto Repair, Services & Parking	11	1.94%	2	1.48%
Business Services	**6**	**1.06%**	**0**	**0.00%**
Communications	1	0.18%	0	0.00%
Educational Services	2	0.35%	0	0.00%
Electric, Gas & Sanitary Services	60	10.58%	8	5.93%
Engineering & Management Services	2	0.35%	0	0.00%
Environmental Quality & Housing	3	0.53%	0	0.00%
General Building Contractors	2	0.35%	1	0.74%
Health Services	2	0.35%	0	0.00%
Justice, Public Order & Safety	1	0.18%	0	0.00%
Manu - Apparel & Other Textile Products	1	0.18%	0	0.00%
Manu - Chemicals & Allied Products	45	7.94%	15	11.11%
Manu - Electronic & Other Electric Equip	**50**	**8.82%**	**4**	**2.96%**
Manu - Fabricated Metal Products	36	6.35%	6	4.44%
Manu - Food & Kindred Products	1	0.18%	1	0.74%
Manu - Industrial Machinery & Equipment	11	1.94%	3	2.22%
Manu – Instruments & Related Products	**5**	**0.88%**	**0**	**0.00%**
Manu - Leather & Leather Products	1	0.18%	0	0.00%
Manu - Lumber & Wood Products	19	3.35%	6	4.44%
Manu - Paper & Allied Products	1	0.18%	0	0.00%
Manu - Petroleum & Coal Products	15	2.65%	6	4.44%
Manu - Primary Metal Industries	34	6.00%	6	4.44%
Manu - Printing & Publishing	1	0.18%	0	0.00%
Manu - Rubber & Misc Plastics Products	**6**	**1.06%**	**0**	**0.00%**
Manu - Stone, Clay & Glass Products	10	1.76%	5	3.70%
Manu - Textile Mill Products	0	0.00%	1	0.74%
Manu – Transportation Equipment	7	1.23%	6	4.44%
Metal Mining	10	1.76%	3	2.22%
Miscellaneous Manufacturing Industries	5	0.88%	1	0.74%
Miscellaneous Repair Services	1	0.18%	0	0.00%

Exhibit 7 (continued) PRIOR USES OF CALIFORNIA STATE SUPERFUND SITES				
Miscellaneous Retail	3	0.53%	0	0.00%
Miscellaneous Services	3	0.53%	0	0.00%
National Security/International Affairs	**77**	**13.58%**	**32**	**23.70%**
Nonclassifiable Establishments	**34**	**6.00%**	**3**	**2.22%**
Nonmetallic Minerals, Except Fuels	1	0.18%	0	0.00%
Oil & Gas Extraction	4	0.71%	1	0.74%
Personal Services	**8**	**1.41%**	**0**	**0.00%**
Pipelines, Except Natural Gas	1	0.18%	0	0.00%
Private Households	1	0.18%	1	0.74%
Railroad Transportation	19	3.35%	3	2.22%
Real Estate	7	1.23%	2	1.48%
Retail - Auto Dealers & Service Stations	3	0.53%	0	0.00%
Retail - Bldg Materials & Garden Supply	0	0.00%	1	0.74%
Social Services	0	0.00%	1	0.74%
Special Trade Contractors	1	0.18%	0	0.00%
Transportation By Air	**5**	**0.88%**	**0**	**0.00%**
Transportation Services	1	0.18%	1	0.74%
Trucking & Warehousing	7	1.23%	3	2.22%
Water Transportation	7	1.23%	2	1.48%
Wholesale Trade – Durable Goods	9	1.59%	2	1.48%
Wholesale Trade – Nondurable Goods	8	1.41%	4	2.96%
Total	**567**		**135**	
Site Universe	**567**	--	**135**	--

Note: Prior uses highlighted in bold font indicate there is a statistically significant difference at the 95% confidence level between the proportions for reused and non-reused sites, based on the "z" test for comparing two population proportions.

Source: State of California CalSites Database, January 2004.

III. Off-Site Factors and Site Reuse Potential

The program data and analysis discussed above focuses on on-site factors that can influence reuse potential, including prior use, contamination, and remedies. In addition to program data, there is a body of literature on on-site characteristics and their impact on reuse. This literature includes research on factors addressed in analysis of program data, as well as factors such as ground water contamination, other environmental concerns (critical habitat, wetlands, etc.), existing site infrastructure, and site location and accessibility. However, a focus on the relationship between these on-site factors and reuse potential ignores the important fact that the development of contaminated

properties, like all real estate development, is heavily influenced by off-site factors. These off-site factors include surrounding land uses and neighborhood characteristics, and most importantly local real estate market conditions.

This section discusses the relationship between contaminated site reuse and the confluence of on-site and off-site factors that affect the feasibility of site reuse, with a specific focus on the role of local real estate conditions. It also discusses the roles of public policies and community involvement in stimulating reuse. The section focuses on the issue from the perspective of private developers, who are an important target for land reuse programs and whose investment decisions regarding site reuse potential are most affected by local real estate markets.

Real Estate Market Conditions

Environmental protection specialists tend to view the cleanup and reuse of contaminated sites as an environmental problem first, and an economic development challenge second. Research on this subject, however, strongly suggests that the feasibility of reusing contaminated land is primarily a real estate equation, one that is complicated but not dominated by environmental and other on-site factors. Real estate literature concerning the reuse of contaminated sites indicates that the local real estate market is a primary determinant of value for any property, whether contaminated or not.[20] Market factors affecting all properties include location, surrounding land uses, and local economic conditions. Related issues, including local crime rates, school quality, and proximity to amenities, also affect the value of sites for reuse. Available research indicates that these factors are the predominant determinants of site reuse potential. A

2000 report by the Economic Development Agency notes that brownfield properties tend to be located in neighborhoods with significant problems affecting development potential, including "poor infrastructure or transportation access, crime, and related ills."[21] A 1997 joint redevelopment study of the Urban Institute, the Northeast-Midwest Institute, the University of Louisville, and the University of Northern Kentucky found that environmental concerns are never the single obstacle that dooms development deals involving contaminated land. In contrast, the study cited market conditions as a critical factor, and noted that contamination issues exacerbate existing concerns related to weak or uncertain market demand.[22] In other words, contaminated properties are often viable for private cleanup and reuse if located within communities with a high demand for development and/or scarcity of developable properties, whereas other properties with similar contamination problems may not be financially feasible to reuse in saturated markets.

Both reports noted that environmental issues matter more when there is little or no difference in the availability and price between properties in greenfield and urbanized areas. The availability of developable greenspace in close proximity to brownfields makes brownfields less attractive investments. For decades, transportation policies, tax policies, and other public policies have essentially subsidized greenfield development, leaving urban areas where brownfields are typically found at a comparative disadvantage in terms of value.[23] In addition, developers often find urban development more difficult than suburban development for a host of reasons that have nothing to do with contamination (e.g., building permit delays, higher development fees, parking

requirements), which is a disadvantage to the reuse of brownfields simply due to their typical location in older urban areas.[24]

Superfund sites, which are often large industrial complexes, landfills and waste treatment centers, and federal facilities tend to be located at the outskirts of urban areas or in more isolated areas than typical brownfields sites. These locations harbor their own real estate challenges apart from contamination, including the quality of infrastructure and roads, and proximity to labor, markets, and suppliers.[25]

Public Policies

Over the past decade, federal, state, and local agencies have spent significant resources to promote reuse of contaminated sites, using subsidies, technical assistance, and liability assurances.[26] Existing research indicates that if a potential reuse project is marginal in terms of financial feasibility, public policies and programs aimed at promoting reuse can positively affect feasibility. For example, the Urban Institute/NEMW/University study noted that developers lacking experience with contaminated properties often had misperceptions regarding liability and cleanup costs that contributed to their reluctance to redevelop contaminated sites. When public programs interceded to correct those misperceptions and aid developers in the environmental due diligence process, many projects succeeded that would otherwise not have gone forward.[27] Another example of the potential impact of public policies is in addressing the disparity of risk preferences between developers and lenders; although developers may be willing to accept the financial risk associated with contaminated properties, they are dependent on lenders, who may be more conservative.[28] Public programs that provide access to capital in the form of grants, low interest loans, loan

guarantees, and low cost environmental insurance can help reuse projects meet financial feasibility thresholds. In addition, for developers concerned about delays in development caused by the need for environmental assessment and cleanup, expedited review and permitting can bolster the feasibility of redevelopment projects.[29]

The challenge for policy makers is to focus programs on sites that fall within the "gray area" of feasibility, to avoid spending limited public resources on sites that will likely be developed without assistance, as well as to avoid wasting resources trying to stimulate private investment in properties that cannot meet real estate investment requirements.[30]

Community Involvement

The interests and involvement of community groups impacted by redevelopment can also play an important role in redevelopment decisions. Community involvement can motivate redevelopment at some sites and present obstacles at others. The influence that communities have is often exerted on issues related to the establishment of cleanup levels and decisions regarding future land use. While the public's input regarding land use decisions is crucial, public refusal to accept anything less than the highest level of cleanup, regardless of future use, can impede reuse.[31] Regarding land use decisions, residents may be wary of such issues as overcrowding of schools and increased congestion that can result from large redevelopment projects, while municipalities may be attracted to potential revenue increases from property taxes. The concerns and perceived benefits of reuse are different for different stakeholders and very site-specific. Thus, designation of cleanup levels and implementation of reuse plans often proves to be

a difficult task as agencies attempt to maintain a balance between environmental protection, economic feasibility, and community interests.

IV. Conclusions

This paper focuses on reviewing available information to characterize the extent and nature of reuse across EPA and state programs that address remediation and reuse of contaminated property, and where possible analyzing characteristics of contaminated sites and their relationship to site reuse. Characteristics that can influence reuse include both on-site factors (e.g., contamination, prior use, site size) and off-site factors (e.g., local real estate market conditions), and public policies (subsidies, technical assistance, and liability assurances). There are limited data available to examine on-site factors in any comprehensive analytic manner. Therefore our analysis is limited to examination of prior use at NPL and California Superfund sites, as well as an analysis of common contaminants at NPL sites. We also reviewed the literature on the role of off-site factors, particularly real estate market conditions, on the reuse potential of contaminated sites.

Overall, the research leaves many unanswered questions regarding the extent and nature of reuse and the characteristics of sites that are being reused. It is not clear how many sites addressed in different programs (particularly RCRA and UST) are reused, or how they are being reused and whether the reuse is sustainable. In addition, sites that are reused are not well characterized in terms of the on-site and off-site factors that increased their reuse potential, or in terms of the relative contributions of various on-site and off-site factors to reuse. In this section, we discuss the findings of our research as they relate to data needs and limitations, the extent of reuse, the influence of on-site characteristics

on reuse, and relative contributions of on-site and off-site factors to contaminated site reuse.

Data Needs and Limitations

One major finding of this research is that useable data to assess the extent of reuse at contaminated sites within and across reuse programs is largely lacking. The lack of reuse data is understandable given the missions of OSWER programs which, with the exception of the Brownfields Program, focus on site cleanup as opposed to reuse. Superfund is the only EPA program that currently has data to analyze the characteristics of reused sites and the potential to compare them to the characteristics of non-reused sites. The SURE database is a supplemental effort to collect reuse characteristics information for NPL sites. Because it is a supplemental effort, however, data elements in SURE are inconsistent with similar data elements in CERCLIS, making comparative analysis difficult. In addition, analyses that rely on these data are hampered by a lack of data on some potentially important characteristics (e.g., site size).

Given OSWER's increasing focus on reuse and interest in characterizing the extent and nature of reuse across its programs, expanding OSWER program data collection efforts to include site characteristics and reuse information would improve research and analytical opportunities. Specifically, OSWER programs could expand existing databases to include reuse information, or develop new and comprehensive systems for collecting and managing cleanup and reuse data. The Brownfields Program has recently undertaken efforts to greatly enhance its collection and integration of reuse data by requiring grantees to maintain individual site profiles that contain site

characteristics and reuse data. The Brownfields Program will then enter these data into its expanded Brownfields Management System where it will be available for analytical purposes. This approach could serve as a model for other programs, and may actually be easier to implement in other OSWER programs because EPA has more control over data collection and management outside of the grantee/grantor relationship of the Brownfields Program.

Extent of Reuse

There is limited information available on the extent of reuse occurring at formerly contaminated sites. From what we know, it appears as though the frequency of reuse of Superfund sites is relatively low. Among NPL sites, the Superfund Redevelopment Program estimates that 335 of 1,948 NPL sites (17 percent) have been reused or are slated for reuse. Of these, 138 (41 percent) have new uses in operation, 94 (28 percent) are slated for reuse, and 103 (31 percent) are sites that have continued or restored prior uses. Based on the State of California's data on the state's Superfund sites, we estimate that 127 of 706 sites, or 19 percent, have been returned to reuse after cleanup. This proportion of reuse is similar to the proportion of NPL sites reused (17 percent). While the extent of reuse cannot be estimated for other programs reviewed, we would expect the proportions to be higher, particularly if continued and restored use are included, because RCRA and UST sites tend to be less contaminated and house more active facilities.

Influence of On-site Characteristics on Reuse

Our preliminary analyses of on-site characteristics are limited by lack of data and the results are mixed and inconclusive. The analysis of contaminants at NPL sites does

not show any one category of contaminant to be correlated with reuse. We expect that the concentration and toxicity of contaminants might have more of an impact on reuse potential than contaminant type. The analysis of NPL site prior uses shows a positive correlation between site reuse and manufacturing and federal facility prior use. This may be partially explained if manufacturing and federal facilities dominate the 103 sites where prior uses may have been continued or restored during and after cleanup. The results also indicate that landfill, waste treatment, and military prior uses are less common among reused sites than all sites. The preliminary analysis of California Superfund sites reveals that of the eight prior use categories with significant differences in proportions between reused and non-reused sites, all except national security/international affairs are less common among reuse sites than all sites, including three manufacturing categories. National security/international affairs is the only prior use that is more common among reuse sites.

Assessing Disparate Factors that Influence Reuse

The literature review of real estate market conditions and contaminated site reuse potential clearly demonstrates that real estate market conditions are a primary driver of reuse at all sites, regardless of contamination, and that contamination is a complicating but typically not a determining factor in the feasibility of reuse. The importance of off-site factors in reuse decisions suggests that information on on-site characteristics are limited in their ability to characterize site reuse potential. In addition, there are likely confounding factors that influence results. For example, although the NPL analysis shows that manufacturing sites are positively correlated with a reuse, causation may lie in the location of these sites or the existing infrastructure at them.

Ideally, policy makers could conduct analyses of contaminated site reuse potential that would integrate on-site and off-site characteristics. However, currently available data do not support such analyses and there is a disconnect between available program data and the literature on reuse characteristics; it is difficult to use one set of information to substantiate the findings of the other. To enable more integrated analyses, EPA or state programs could conduct local case study analyses to assess the relative contributions of reuse factors. Such analyses might require in-depth data collection on contaminated sites in a particular locale, and would include all of the relevant on-site factors (e.g., site size, type and extent of contamination, prior uses), as well off-site factors (e.g., real estate market trends, site accessibility, availability of public policy incentives and subsidies). Results from such local analyses would be valuable in identifying the relative contributions of various reuse factors in characterizing reuse potential.

Appendix A

SUMMARY OF E^2 CASE STUDIES (REUSE FACT SHEETS)

Exhibit A-1

SUMMARY OF E^2 CASE STUDIES
(REUSE FACT SHEETS)

Project	OSWER Program Office	Type of Reuse	Acres*
Aspen Grove Lane, Burnsville, MN	Brownfields	Residential	2.3
Atlantic Steel, Atlanta, GA	RCRA	Residential and commercial (retail, office, entertainment)	138
Century Brass, Waterbury, CT	RCRA	Commercial	90
Chisman Creek, York County, VA	Superfund	Recreational (softball and soccer fields)	--
Clearwater, FL	UST	Medical (non-profit health clinic)	--
Commodore Semiconductor Group, Norristown, PA	Superfund	Commercial (future intended use)	10+
Copeland Service Station, Milwaukee, WI	UST	Commercial (coffee shop)	--
Denver Radium, Denver, CO	Superfund	Commercial	17
Gateway District, Salt Lake City, UT	Brownfields	Residential and commercial (retail, museum, theatre)	40
General Electric Appliance Park East, Columbia, MD	RCRA	Commercial (offices, retail, restaurants, theatre)	21
Houston, TX	UST	Commercial (baseball stadium, restaurants, offices)	--
Jackson, MI	Brownfields	Commercial (power utility corporate headquarters)	(3 blocks)
Kane and Lombard Street Drums, Baltimore, MD	Superfund	Recreational (golf driving range)	--
Kenosha Lakefront, Kenosha, WI	RCRA	Recreational (park), residential, commercial (museum), and transportation (streetcar system)	69
Northern Type Printing, Glen Cove, NY	Brownfields	Commercial	--
Pontiac Centerpoint, Pontiac, MI	RCRA	Industrial (assembly line manufacturing) and commercial (business park, restaurants, hotels, retail)	--
Prestolite Battery, Vincennes, IN	Superfund	Commercial	--
Publicker Industries, Philadelphia, PA	Superfund	Industrial (cargo handling facility) and transportation (passenger ship terminal)	42
Rocky Mountain Arsenal, Denver, CO	Superfund	Recreational (trails and bike paths) and ecological (wildlife refuge)	--
Sparton Technology, Albuquerque, NM	RCRA	Commercial (car dealership)	12
St. Louis Commerce Center, St. Louis, MO	Brownfields	Commercial	20
Taft Garage, Lincoln City, OR	UST	Residential	--
West Ogden Avenue, Chicago, IL	UST	Ecological (pocket park)	--

Exhibit A-1 (continued)

SUMMARY OF E^2 CASE STUDIES
(REUSE FACT SHEETS)

Westinghouse Electric, Emeryville, CA	Brownfields	Residential and commercial	20
Whitney Screw, Nashua, NH	UST	Commercial (retail, offices)	5.4

* All values are approximate. Dashes indicate that acreage data are not available.

Appendix B

ANALYSIS OF EXTENT AND NATURE OF REUSE OF SUPERFUND SITES

Exhibit B-1

COMPARISON OF NPL STATUS AT ALL NPL SITES AND REUSED NPL SITES

NPL Status	All Sites (CERCLIS)	All Sites (SURE)
Currently on Final NPL	1,241	268
Deleted from Final NPL	276	80
Proposed for NPL	54	5
Removed from Proposed NPL	61	1
Site is Part of NPL Site	310	1
Withdrawn	6	0
Total	**1,948**	**355**

Exhibit B-2 ANALYSIS OF REUSE INDICATORS IN SURE DATABASE	
Number of Sites	**Element**
REUSE INDICATOR	
Reuse Status[1]	
138	Actual New (New use is in operation.)
95	Actual Continued (Site has been used productively during and after the cleanup.)
46	Definite Planned (Detailed plan for a new use is in place; redevelopment has been initiated or will be initiated in the near future, or there is a contract with a developer and finances are secured.)
1	Early Stages of Planning (Site-specific reuse plan is complete or very near completion, and reuse options have been determined to be viable.)
47	Monitored (Reuse options are being discussed within the community, as reported by regions or in local or national media.)
8	Restored (Site was returned to prior use after cleanup.)
335	**Total Entries for Reuse Status**
335	**Sites with Reuse Status Data**
Reuse Type	
146	Commercial
66	Recreational
58	Industrial
42	Ecological
35	Public
32	Residential
29	TBD
11	Agricultural
2	Military
0	Commercial/Recreational
418	**Total Entries for Reuse Type**
335	**Sites with Reuse Type Data**
Remedial Action	
328	Other
246	Institutional Controls
223	Containment
222	Physical/Chemical Treatment (Ex-Situ - Assuming Excavation)
192	Physical/Chemical Treatment (Ex- Situ - Assuming Pumping)
102	Physical/Chemical Treatment (Ex-Situ)
79	Air Emissions/Off-Gas Treatment
76	Residuals (Secondary) Treatment
69	Physical/Chemical Treatment (In-Situ)
37	Biological Treatment (In-Situ)
26	Thermal Treatment (Ex-Situ - Assuming Excavation)
23	Biological Treatment (Ex-Situ – Assuming Excavation)
18	Thermal Treatment (Ex-Situ)
15	Biological Treatment (Ex- Situ – Assuming Pumping)
6	Thermal Treatment (In-Situ)
1662	**Total Entries for Remedial Action**
341	**Sites with Remedial Action Data**

Exhibit B-2 (continued) ANALYSIS OF REUSE INDICATORS IN SURE DATABASE	
Institutional Controls	
145	Institutional Controls (general/not otherwise specified)
133	Access Restriction, Fencing
335	***Total Sites with reuse information in SURE***
88	Deed Restriction
82	Access Restriction
49	Access Restriction, Guards
32	Water Supply Use Restriction
31	Land Use Restriction
10	Swimming Restriction
9	Deed Notices
9	Groundwater use/well drilling regulation
8	Drilling Restriction
7	Covenant
6	Zoning regulation
5	Fishing Restriction
4	Easement
3	Building, demolition, or excavation regulation
3	Consent Decree
2	Listing on State Hazardous Waste Registry
2	Notice in Newspaper
2	Notices to State Regulators Before Changes in Land Ownership
1	Listing on Local Hazardous Waste Registry
1	Public meetings
1	Recreational Restriction
1	Unilateral Administrative Order
634	**Total Entries for Institutional Controls**
246	**Total Sites with Institutional Controls**
Institutional Control Objective	
4	Prohibit drinking groundwater
3	Prohibit other use of groundwater (industrial, food preparation, gardening, agricultural, etc.)
3	Protect integrity of an engineered remedy
3	Provide information to modify behavior
2	Prohibit dermal contact
2	Prohibit pumping groundwater(plume movement)
2	Prohibit residential exposure scenario
1	Prohibit utility worker/excavation exposure scenario
1	Prohibit recreational exposure scenario
1	Education
22	**Total Entries for Institutional Control Objective**
9	**Total Sites with Institutional Control Objectives**
Source: SRA International, Superfund Redevelopment Program, SURE Database, January 5, 2004 .	

Exhibit B-3

COMPARISON OF CONTAMINANTS AT ALL NPL SITES AND REUSED NPL SITES

Contaminant	All Sites (CERCLIS)		Reuse Sites (SURE)	
	# Contaminant Occurrences	% Contaminant Occurrences	# Contaminant Occurrences	% Contaminant Occurrences
Acids	31	0.609%	12	0.978%
Base Neutral Acids	595	11.690%	140	11.410%
Cement Kiln Dust	3	0.059%	1	0.081%
Dioxins/Dibenzofurans	199	3.910%	59	4.808%
Dissolved Solids (Total)	8	0.157%	0	0.000%
Flammables	2	0.039%	1	0.081%
Inorganics	523	10.275%	119	9.698%
Leachate	1	0.020%	0	0.000%
Metals	928	18.232%	231	18.826%
Nitrate/Nitrate	1	0.020%	0	0.000%
Nitroaromatics	64	1.257%	21	1.711%
Oil & Grease	24	0.472%	5	0.407%
Organic & Inorganic Liquid Sludge	4	0.079%	1	0.081%
Organics	132	2.593%	34	2.771%
Oxidizers	1	0.020%	1	0.081%
PAH	679	13.340%	155	12.632%
PCBs	398	7.819%	92	7.498%
Pesticides	408	8.016%	90	7.335%
Petroleum Hydrocarbon	59	1.159%	20	1.630%
Radioactive	64	1.257%	13	1.059%
Reactives	1	0.020%	0	0.000%
Unknown Liq Waste	8	0.157%	2	0.163%
VOC	957	18.802%	230	18.745%
Total Contaminant Occurrences	**5,090**	**100%**	**1,227**	**100%**
Total Sites	**1,847**	**--**	**272**	**--**

Exhibit B-4

SURE Database Coding Assumptions for Prior Use

Prior Use	Inclusions
Chemical Plant	Battery and pesticide production, lead battery recycling, dry cleaning, solvent reclamation and sales, solvent distillation, and sites with chemical manufacturing
Housing Area/Farm	Residences, farms and farm-related activity
Industrial Waste Treatment	Disposal facilities, waste management facilities, hazardous waste facilities, asbestos processing, waste oil reclamation/recycling
Landfill	Municipal waste, sanitary landfill/energy generation plant, areas filled with waste material for development, dumps, industrial landfills, disposal areas
Manufacturing	Wood treatment/processing, metal, coal, gas, and tar processing, creosote plants (oily liquid distilled from coal and tar)
Other	Recycling drums, petroleum storage, and sites with a wide range of multiple uses
Pure Lagoons	Lagoons, illegal dumps and non-sanctioned waste sites, and granite quarries used as industrial dumps
Radioactive	Ordnance (artillery, ammunition), DOE and DOD sites

Appendix C

STATE PROGRAM REUSE INFORMATION

Appendix C

STATE PROGRAM REUSE INFORMATION

State	Program	Source	Number of Contaminated Sites	Number of Reused Sites	Type of Contamination	Reuse Type	Prior Use	Response Action
California	Site Mitigation and Brownfields Reuse Program	CalSites Database	706	127	Available in site background description.	Provided for 127 sites.	Provided for 702 sites.	Provided for some sites.
Illinois	Site Remediation Program	2001 Annual Program Report	1,673	Not provided.	Available in case study descriptions.	Not clear; type of site provided for some sites.	Not clear; type of site provided for some sites.	Available in case study description.
Illinois	Site Remediation Program	Site Remediation Program Database	2,016	Not provided.	Not provided.	Not clear; type of site provided for all sites.	Not clear; type of site provided for all sites.	Institutional controls and barriers specified for some sites.
Indiana	Brownfields Program	Website; Success Stories	Not provided.	Not provided.	Available in site descriptions.	Available in site descriptions.	Available in site descriptions.	Available in site descriptions.
Massachusetts	Brownfields Redevelopment Fund Program	2002 Brownfields Report Update	297	Not provided.	Not provided.	Provided for all sites.	Provided for all sites.	Available in case study descriptions.
Massachusetts	Waste Site Cleanup	WSC Database	27,340	Not provided.	Provided for all sites.	Not provided.	Not clear; provides type of area affected.	Provided for all sites.
Michigan	Clean Michigan Initiative	Brownfields Database	2890	Not provided.	Provided for all sites.	Not provided.	Provided for all sites.	Not provided.
Missouri	Hazardous Waste's Voluntary Cleanup Program	Brownfield/ Voluntary Cleanup Site List	411	Not provided.	Not provided.[1]	Not provided.	Not provided.	Not provided.

Appendix C (continued)

STATE PROGRAM REUSE INFORMATION

New Jersey	Site Remediation Program	Known Contaminated Sites in NJ 2001 Report and Database.	13,727	Not provided.	Available in site descriptions.	Not provided.	Not provided.	Not provided.
Pennsylvania	Land Recycling Program	Defining Results, 2001 Annual Report	1,394	Not provided.	Available in site descriptions.	Not provided.	Available in site descriptions.	Available in site descriptions.
Texas	Voluntary Cleanup Program	Texas VCP Database	Not available.	Not provided.	Provided for nearly all sites.	Not clear; type of site provided for all sites.	Not clear; type of site provided for all sites.	Type of remedy specified for some sites.
Washington	Toxics Cleanup Program	2002 State of Cleanup Report	9,076	Not provided.	Aggregated across all sites per contaminant group.	Not provided.	Examples provided.	Examples provided.

[1]Website indicates that information on contamination is available in the Missouri Registry Annual Report.

ENDNOTES

[1] The Federal Facilities Restoration and Reuse program activities and reuse information are not discussed in this paper.

[2] E^2, Cross-OSWER Reuse Fact Sheets, draft version, prepared for US EPA/OSRTI, October 2003.

[3] Data on the beneficial effects of reuse are discussed in a companion paper entitled, *Overview of Existing Studies on Community Impacts of Reuse.*

[4] EPA announced 10 Superfund Redevelopment Initiative pilots in 1999, 40 in 2000, and 19 in 2002, for a total of 69 pilot cities, http://www.epa.gov/superfund/programs/recycle/pilot/index.htm.

[5] Data on the NPL status of sites in the SURE database are detailed in Appendix B, Exhibit B-1.

[6] A more detailed breakout is presented in Appendix B, Exhibit B-2.

[7] US Environmental Protection Agency, definition of institutional controls, http://www.epa.gov/superfund/action/ic/.

[8] Because coded contaminant information is not available in the copy of the CERCLIS database used for this analysis, we conducted online searches of CERCLIS to determine the frequency of contaminants across sites. The number of sites with each contaminant is systematically higher in SURE compared to CERCLIS, which is likely attributable to differences in how the two databases handle reporting of multiple contaminants at each site.

[9] Detailed results are presented in Appendix B, Exhibit B-3.

[10] In SURE, this information was presented as a description, and therefore was coded to correspond to the respective "site incident" category in CERCLIS. To code these data, we made assumptions that introduce uncertainty into the analysis; these assumptions are listed in Appendix B, Exhibit B-4. For the purpose of this analysis, prior use categories were narrowed down to the eleven categories presented in Exhibit 5. All other categories in CERCLIS, including abandoned, city contamination, dioxin, and wells, were grouped into the "Other" category. Each site was coded with only one prior use in both SURE and CERCLIS.

[11] U.S. Environmental Protection Agency, *Reusing Land and Restoring Hope: A Report to Stakeholders from the US EPA Brownfields Program,* November 20, 2003.

[12] Brownfields Cleanup and Redevelopment, Brownfields Mission, www.epa.gov/brownfields/mission.htm.

[13] Provided by the Office of Brownfields Cleanup and Redevelopment, January 22, 2004.

[14] The low proportion of properties reporting reuse information is a result of the voluntary nature of the program, and the management of the data by local grantees. BMS contains more complete data on some socioeconomic indicators, including jobs and investment dollars leveraged.

[15] RCRA Brownfields Prevention Initiative web page, www.epa.gov/swerosps/rcrabf/index.html.

[16] EPA, Office of Underground Storage Tanks, *Memorandum: FY 2003 Semi-Annual End-of-Year Activity Report*, November 2003.

[17] Federal brownfields legislation passed in January 2002 requires states to maintain, and make public, information on future use limitations and institutional controls at brownfields sites in state programs. This legislation may result in more comprehensive data collection of reuse information across states and the development of state databases with cleanup and reuse information.

[18] Sites assumed not to have been reused have zeroes in the reuse type fields. It is unclear whether zeroes indicate no reuse or incomplete data.

[19] SIC codes are not included for four Superfund sites that have not been reused.

[20] Jack Ackerman, Vanasse Hangen Brustlin, "Potential Brownfields Projects: The Good, the Bad, and the Ugly,"

July 1999, www.environews.com/centers/good.html.

[21] Ibid and Peter Meyer et al., *Reclamation and Economic Regeneration of Brownfields*, prepared for the US Economic Development Administration, 2000.

[22] Urban Institute, Northeast-Midwest Institute, University of Louisville, University of Northern Kentucky, *The Effects of Environmental Hazards and Regulation on Urban Redevelopment*, submitted to U.S. Department of Urban Development, Office of Policy Development and Research, U.S. Environmental Protection Agency, August 1997.

[23] Ibid, and Peter Meyer et al., *Reclamation and Economic Regeneration of Brownfields*, prepared for the US Economic Development Administration, 2000.

[24] Beth Mattson-Teig, "Growing Up, Not Out: Cities Use Infill Development to Alleviate Sprawl," *Commercial Investment Real Estate*, November/December 2003.

[25] Kris Wernstedt, Robert Hersh, and Katherine Probst, *Basing Superfund Cleanups on Future Land Uses: Promising Remedy or Dubious Nostrum?,* October 1997.

[26] Northeast/Midwest Institute, *Guide to Federal Brownfields Programs*, 2000, http://www.nemw.org/FedGuide2000.pdf;

[27] Urban Institute, Northeast-Midwest Institute, University of Louisville, University of Northern Kentucky, *The Effects of Environmental Hazards and Regulation on Urban Redevelopment*, submitted to U.S. Department of Urban Development, Office of Policy Development and Research, U.S. Environmental Protection Agency, August 1997.

[28] Peter Meyer et al., *Reclamation and Economic Regeneration of Brownfields*, prepared for the US Economic Development Administration, 2000.

[29] US EPA, Environmental Financial Advisory Board, *Expediting Clean-Up and Redevelopment of Brownfields: Addressing the Major Barriers to Private Sector Involvement -- Real or Perceived*, December 1997, and General Accounting Office, *Hazardous Waste: Remediation Waste Requirements Can Increase the Time and Cost of Cleanups*, October 1997, GAO/RCED-98-4.

[30] Several guidebooks and tools exist to help policy makers triage sites for this purpose, including: ICMA, *Brownfields Redevelopment: A Guidebook for Local Governments and Communities—Second Edition*, 2001, and Industrial Economics, Incorporated, *An Integrated Approach for Successful Brownfields Redevelopment*, prepared for the Office of Policy, US Environmental Protection Agency, September, 1996.

[31] Urban Institute, Northeast-Midwest Institute, University of Louisville, University of Northern Kentucky, *The Effects of Environmental Hazards and Regulation on Urban Redevelopment*, submitted to U.S. Department of Urban Development, Office of Policy Development and Research, U.S. Environmental Protection Agency, August 1997, and Kris Wernstedt, Robert Hersh, and Katherine Probst, *Basing Superfund Cleanups on Future Land Uses: Promising Remedy or Dubious Nostrum?,* October 1997.